Announcements

- 1st EXAM on *Tuesday, Feb. 14!*
- Homework for tomorrow…

  Ch. 28: CQ 7, Probs. 20, 22, & 34

  CQ1: a) 6 b) 3/2
  CQ2: a) 2×10^{-12} J b) 1×10^{-12} J
  28.6: 0J
  28.36: a) 0.72 J b) 14 N c) 11 m/s, 22 m/s

- Office hours…

  MW 10-11 am
  TR 9-10 am
  F 12-1 pm

- Tutorial Learning Center (TLC) hours:

  MTWR 8-6 pm
  F 8-11 am, 2-5 pm
  Su 1-5 pm

Chapter 28

The Electric Potential

(*…inside a Parallel-Plate Capacitor &*
…of a Point Charge)

Last time…

- The *Electric Potential* (a.k.a. Voltage)..

$$V = U_{q+sources}/q$$

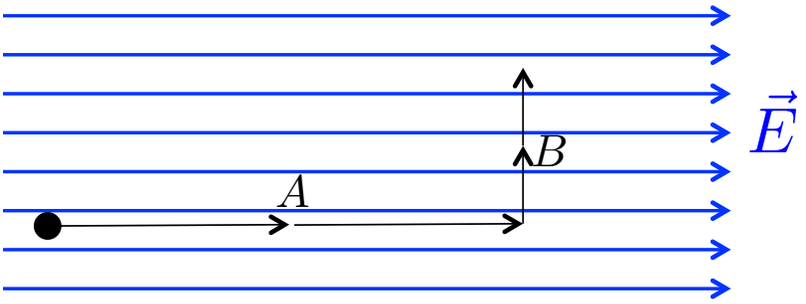
- *Electric Potential* in a parallel-plate capacitor…

$$V = Es$$

Quiz Question 1

A *negative* charge is moving through an *electric field* along a path consisting of 2 legs (A & B). Let W represent the work done by the field, and ΔV the change in potential.

Which of the following statements is/are true:



I. $W_A > 0$

II. $W_B > 0$

III. $\Delta V_A < 0$

IV. $\Delta V_A > 0$

1. I only
2. I and II
3. III only
4. I and III
5. II and IV

Potential inside a Parallel-Plate Capacitor..

Notice:

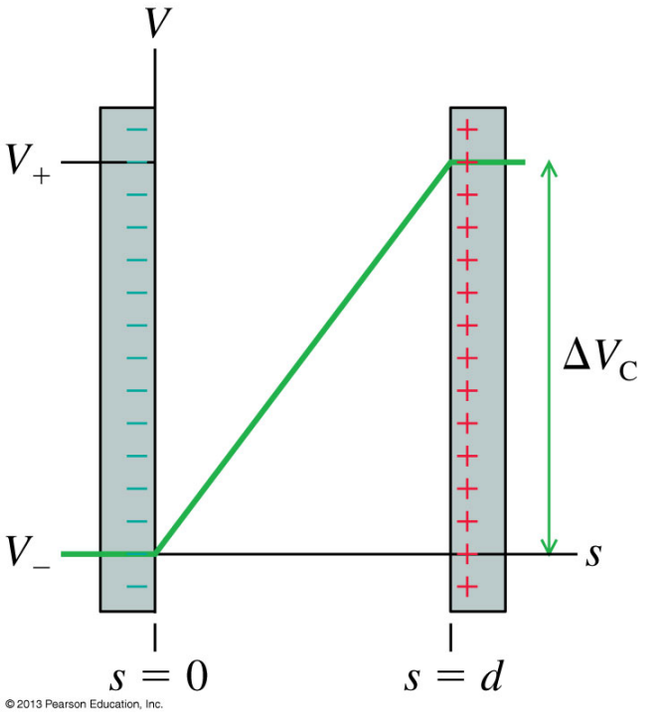
We can define the *potential difference* between the two capacitor plates

$$\Delta V_C = V_+ - V_- = Ed$$

or

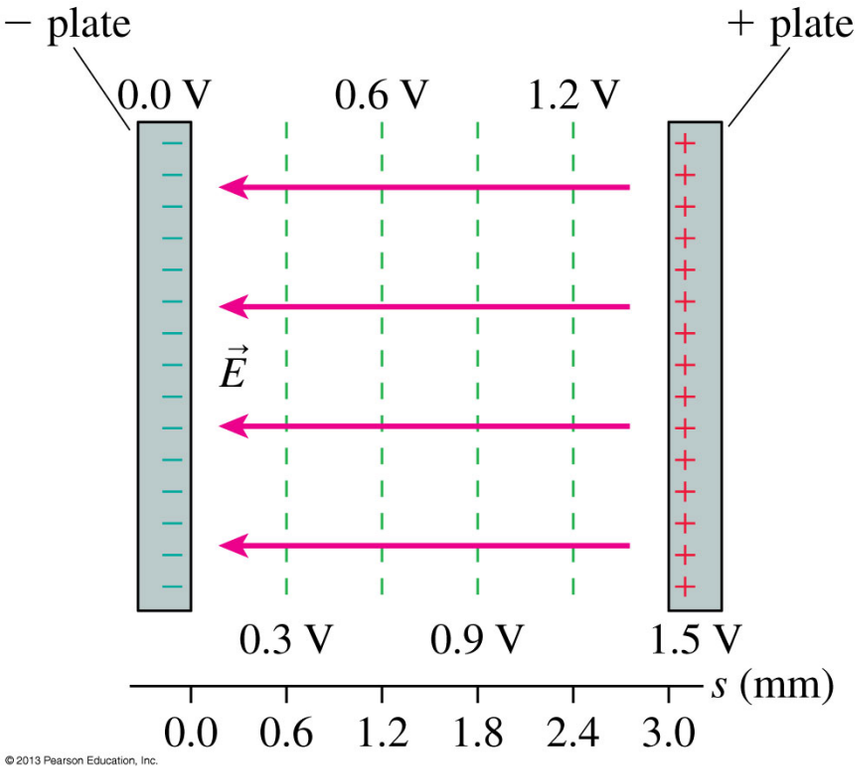
$$E = \frac{\Delta V_C}{d}$$

- SI Units?



Potential inside a Parallel-Plate Capacitor..

Lines of *equipotential*...



Quiz Question 2

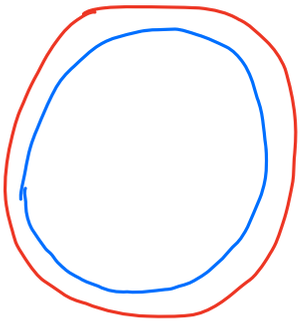
If a *positive* charge is released from rest, it moves in the direction of

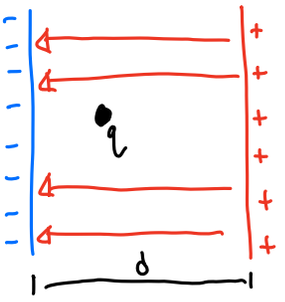
1. a stronger electric field.
2. a weaker electric field.
3. higher electric potential.
4. lower electric potential.
5. Both 2. and 4.

i.e. 28.8: The force on an ion

Ex. 26.7 noted that a cell wall can be modeled as a parallel-plate capacitor, with the outer surface of the cell wall being positive while the inner surface is negative. The potential difference between the inside of the cell and the outside is called the *membrane potential*. Suppose a molecular ion with charge $5e$ is embedded within the 5.0 nm thick wall of a cell with a *membrane potential* of -70 mV, typical for a nerve cell in its resting state.

What is the force on the molecular ion?





$q = 5e = 8.0 \times 10^{-19}\,C$

$d = 5.0 \times 10^{-9}\,m$

$\Delta V = 7.0 \times 10^{-2}\,V$

$$E = \frac{\Delta V}{d} = \frac{7.0 \times 10^{-2}\,V}{5.0 \times 10^{-9}\,m}$$

$$E = 1.4 \times 10^{7}\,V/m$$

$$F = qE$$

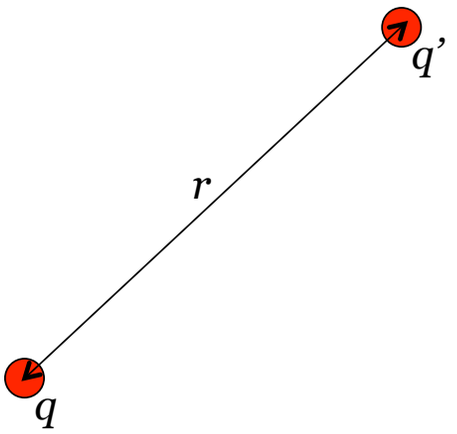
$$F = 1.6 \times 10^{-19}\,C\left(8.0 \times 10^{7}\,\frac{V}{m}\right)$$

$$F = 1.1 \times 10^{-11}\,N$$

28.6: The Electric Potential of a Point Charge

The *Electric Potential Energy* of the two point charges is…

$$U_{q'+q} = \frac{Kqq'}{r}$$



So, what's the *Electric Potential* of charge *q*?

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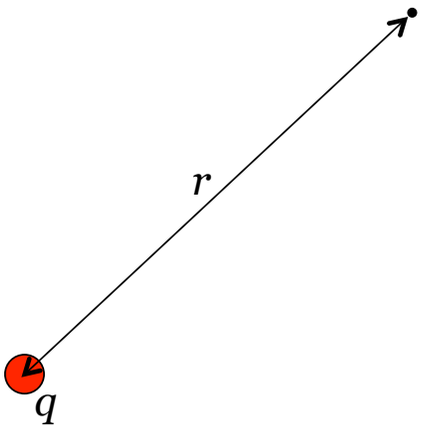
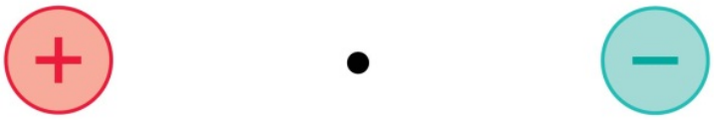


So, what's the *Electric Potential* of charge q?

$$V = \frac{Kq}{r}$$

Quiz Question 3

At the midpoint between these two equal but opposite charges,



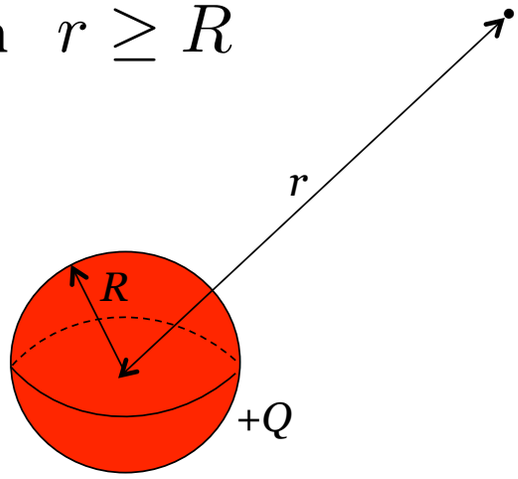
1. $E = 0$; $V = 0$.
2. $E = 0$; $V > 0$.
3. $E = 0$; $V < 0$.
4. E points right; $V = 0$.
5. E points left; $V = 0$.

The Electric Potential of a Charged Sphere

The *Electric Potential* of a uniformly charged sphere is...

$$V = \frac{KQ}{r}$$

when $r \geq R$



i.e. 28.10:
A proton and a charged sphere

A proton is released from rest at the surface of a 1.0 cm diameter sphere that has been charged to +1000V.

a. What is the charge of the sphere?

b. What is the proton's speed at 1.0 cm from the sphere

$R = 5.0 \times 10^{-3}\ m$

$V(R) = 1000\ V$

$U_0 + \cancel{K_0}^{0} = U_1 + K_1$

$U_0 = U_1 + K_1$

$V = \frac{Kq}{r}$

$q = \frac{Vr}{K}$

$q = 5.6 \times 10^{-9}\ C$